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(71)(72) Applicant and Inventor: KAAS, Povl [DK/DK]; Th. Nielsens Gade 11 G, DK-7400 Herning (DK).

(74) Agent: HOFMAN-BANG & BOUTARD, LEHMANN & REE A/S; Ryesgade 3, P.O. Box 367, DK-8100 Aarhus C (DK).

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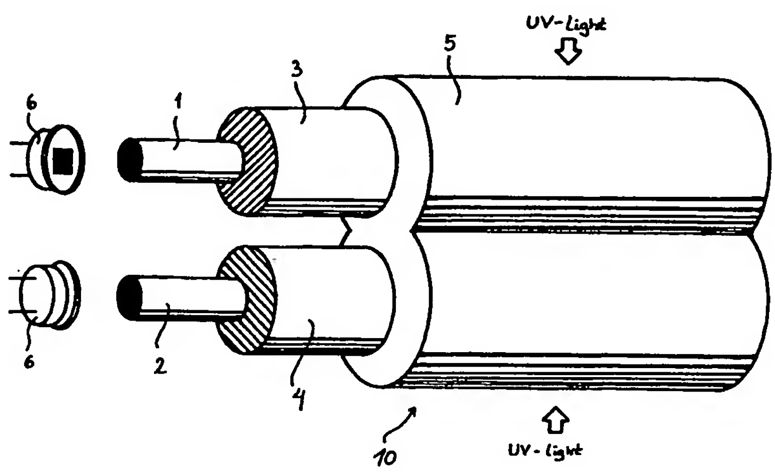

(57) Abstract

The invention relates to a device for light intensity measurement of the electromagnetic radiation from a lamp device comprising at least one UV lamp preferably of the type arranged in a container in connection with disinfection or photocheminal treatment of flowing water, wherein the radiation intensity is measured using light guide means and sensor means, said light guide means comprising two dosed light guides (1, 2) arranged in parallel with the lamp or lamps preferably in the entire length and two differently dosed edge glass filters (3, 4) enclosing each of the light guides, said sensor means (6) being positioned at one end of each of the light guides. A device according to the invention allows measurement of predefined wavelengths of emitted electromagnetic radiation along the entire lamp, whereby the total emitted radiation intensity from the lamp may be measured. The invention moreover relates to a reaction container with indication of the positioning of UV lamps and intensity meter.

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A device for intensity measurement of UV light from a lamp and a UV treatment plant equipped with such a device

The present invention relates to a device for intensity measurement of the electromagnetic energy from a lamp device comprising at least one UV lamp preferably of the type arranged in a container in connection with disinfection or photochemical treatment of flowing water, wherein the light intensity is measured using light guide means and sensor means. The invention moreover relates to a UV treatment system, preferably a UV disinfection system or photochemical reaction system in which a lamp device comprising evenly arranged UV lamps is arranged.

Such a device for intensity measurement and a reaction container is known from US-A-4 201 916 among others, where the ultraviolet light from the UV lamps in a UV treatment container is measured in a tube opening in the container wall adjacent one of the UV lamps in the container. The position of this tube opening and thereby the measuring point relative to the lamps are selected such that, based on the light radiation characteristic of the UV lamps, the measurement may be expected to be as representative as possible. Most lamp makers who manufacture UV lamps and who have measured on the UV lamps, state a non-uniform light distribution relative to the length of the lamp, particularly in case of low pressure lamps of U-shape or low pressure lamps of lengths above 1 metre. Measurement of primarily one UV lamp has given an approximately correct measurement with one point measurement of the intensity of UV light, the UV lamp device being considered as a uniform light source.

EP-A-0 531 159 describes a light detector in which a fluorescent fibre is used for the detection of light of

low intensity. The fibres are secured to a panel which serves as a concentrator or a light collector.

In cylindrical UV systems having more than one UV lamp e.g. for disinfection of water or other forms of liquids it is impossible to measure the real energy per volume, and how much UV energy is present at the weakest points in the system having a single point light meter which is mounted on the cylindrical container wall.

To be certain that the system carries out a complete disinfection of the water flowing through it, a minimum illumination of the water must be ensured. It has been found in this connection that bacteria, if any, in the water are inactivated by an illumination of at least 5.4 mJ/cm^2 UV energy with a wavelength $\lambda = 253.7$ nm.

However, it is a problem if there are areas in the container which are not sufficiently illuminated because of one or more defective or malfunctioning UV lamps. To guarantee a minimum of UV illumination of the entire container, the container is illuminated with an UV illumination which is somewhat above the minimum value, which consumes energy and causes the operation of such systems to be relatively costly. The thus high load of the individual UV lamps moreover has the effect that the service life of the lamps is shortened, which in turn means high maintenance costs.

The problems outlined above are even more pronounced in ducts or channel systems where the UV lamps - typically mounted in cartridges - are positioned vertically in the channel or in its longitudinal direction. The channels have a rectangular cross-section, and the water flow in them is horizontal in the longitudinal direction of the channels.

The object of the invention is to provide a device for measuring the intensity of the electromagnetic energy from a lamp device having one or more UV lamps in a reaction system, which provides a more accurate intensity measurement, and which is more economical in operation and maintenance.

According to the invention, the light guide means comprise two dosed light guides arranged in parallel with the lamp or lamps preferably in the entire length, and two differently dosed edge glass filters enclosing each of the light guides, and the sensor means are positioned at least at one end of each of the light guides.

With a device according to the invention it is possible to measure predefined wavelengths of emitted electromagnetic energy along the entire lamp, whereby the total emitted light intensity from the lamp may be measured. The two dosed edge glass filters absorb the UV light below a certain wavelength and thus merely allow light having a greater wavelength than the absorption value of the edge glass to pass. The radiations with which the two light guides are illuminated, thus exhibit different wavelengths. The intensity of the UV illumination of the two light guides is measured by sensor means which are arranged at the ends of the light guides. Passage of the UV light, which is converted into an electrical signal in the sensor means, will be a problem for an ordinary photodiode, which is thereby exposed to a high UV light energy. The relatively short waves very quickly burn dark spots on the silicon monocrystal, which should otherwise be most resistant to UV light in connection with photodiodes. When dark spots occur on the crystal, the measurement is wrong, as the current signal is no longer correct relative to the UV light energy. A signal which is no

longer correct necessitates frequent calibration of the UV intensity meter. After some time it will be necessary to replace the meter, since the meter, even at the last calibration, will involve a too high measurement unreliability.

The light guides in a device according to the invention are dosed such that the UV light passing through the edge glasses and into the light guides is converted into another less harmful wavelength. This results in a considerably longer service life of the sensor means.

For an accurate measurement to be achieved, it is important that there is no great loss of UV light across the edge glass filter. It has been found with an intensity meter according to the invention that a passage of UV light of more than 92% can be achieved, which compared to known UV intensity meters is considerably better. In addition, a thus cable-like device according to the invention provides a considerably wider incidence angle or opening angle for the UV light.

In a preferred embodiment of a light guide device consisting of two light guides, the total opening angle is thus 320° per light guide. It has been found that the sensitivity in the range of one light guide device is:

$$0 \text{ to } \pm 145^0 \geq 95\% \text{ and from } 145° \text{ to } 160° \geq 80\%.$$

A light guide device having two light guides in pairs, a total of four light guides according to the invention, thus measures with an opening angle per light guide of ± 115°. It has been found that the sensitivity in the range is :

$$0° \text{ to } \pm 105° \geq 95\%, \text{ and from } \pm 105° \text{ to } \pm 115° \geq 80\%,$$

which is a considerable, extremely satisfactory sensitivity for a light intensity meter.

In order to further reduce the loss of light in the light guides, reflection means are arranged at the other end of the light guides in a preferred embodiment.

In a preferred embodiment for UV disinfection, the first edge glass filter is dosed to a filter wavelength of about 245 nm, and the second edge glass filter is dosed to a filter wavelength of about 260 nm. This means that a small bandwidth of between λ = 245 - 260 nm is achieved in connection with the measurement of the UV light. Taking the measured signal from the first light guide and subtracting from it the corresponding signal from the second light guide gives a signal which is representative for the level of the intensity of light having λ = 253.7 nm. For photochemical processes, it has been realized by the invention that other edge glasses having a different dosing may be used, if another bandwidth and/or another nominal value of the representation signal is desired. This may be attractive particularly in connection with e.g. photochemical systems for removal of chloramines, THM and AOX in swimming pool water which uses chlorine as a disinfectant, it being possible to select two different edge glasses for defining a range which is within the narrow wave range of a dosed intermediate pressure lamp which is used in connection herewith.

In a preferred embodiment, one or both light guides are dosed for converting ultraviolet light fed through the edge glass filters into visible light, preferably with a wavelength of 430-470 nm. This makes it possible to use an ordinary and inexpensive photodiode sensitive to light in the blue range and having a long service life. Thus,

calibrations will not be needed, since such photodiodes can give a substantive, accurate current signal for an extremely long time. In a particularly advantageous embodiment of the sensor means, they consist of silicone silicon photodiodes. Another essential advantage is of course that a silicon photodiode having a high sensitivity in the blue range is not degraded, as would be the case if measurements were performed directly on the UV light energy with $\lambda = 253.7$ nm.

In systems with many UV lamps and consequently a large diameter it is an advantage in connection with the achievement of a high resolution that the light guide means comprise two or more light guides arranged in pairs with associated dosed edge glass filters. Thus, a greater total opening angle is achieved.

In a preferred embodiment, the two edge glass filters enclosing the light guides are embedded in a jacket of a transparent material, preferably quartz glass having two or more channels arranged in pairs for the edge glass filters. This provides a form of light guide cable for light intensity measurement. This cable may be produced in lengths from 10 mm up to 6000 mm corresponding to the lengths of the lamps.

In case of a large number of lamps or high power lamps of e.g. 1 kW light energy or more, the intake of light energy is so great that the signal becomes so strong that saturation occurs in the electronics of the controller. By using a jacket of a transparent material, preferably quartz glass dosed to a grey filter, the light intensity meter may hereby be used irrespective of the level of light energy, as the attenuation may be adapted thereto. A grey filter with e.g. 5% linear attenuation or 10% lin-

ear attenuation, etc. may be used according to the light energy.

It will be appreciated that the device according to the invention is generally useful. Thus, the device may also be used for measuring the UV intensity in rooms where a specific UV energy is desired for inactivating e.g. microfungi or bacteria, such as in the tobacco, food and cheese industries, laboratories and hospitals. Since light guides may be manufactured in lengths of up to about 10000 metres, and since they are relatively flexible, this opens up great possibilities of measuring correctly where it has not been possible before. Light guides may be manufactured with a diameter as low as 50 µ, which also contributes to the usefulness of the invention.

The invention may also be applied in connection with conveyors, e.g. conveyor belts for advancing food products before and during packaging, e.g. in the bread and fish industries. Here, a device according to the invention may be placed in the entire length of the conveyor channel at the weakest point.

Furthermore, the invention may be applied in connection with ventilation systems where it is desired to treat the air for microorganisms. Devices according to the invention may thus be placed in the ventilation channels at expedient points.

Another application of the invention is for water treatment in channel systems or long pipe systems with many lamps, where it has not previously been possible to obtain an even tolerably correct measurement of the UV intensity.

Also, the invention may very advantageously be applied in connection with UV light treatment of patients, e.g. psoriasis patients. The flexible light guide device may be arranged on the patient exactly where the treatment is to be performed.

The invention moreover comprises a UV treatment system, preferably a UV disinfection system or photochemical reaction system in which a device for light intensity measurement according to the first aspect of the invention is arranged in parallel with the lamps.

In a UV treatment system having a cylindrical container of circular or polygonal cross-section, the centre is the most weakly illuminated point in the container having two or more UV lamps arranged in a circle. By placing the intensity meter at this point the correct value of the light intensity may be measured with extremely satisfactory accuracy. In containers including only one UV lamp, this lamp is placed in the centre, and the intensity meter is placed between the lamp and the container wall. In systems having a channel-shaped container with at least one intensity meter, this is likewise placed between the lamps and the internal channel wall.

US-A 4 103 167 discloses an expensive and difficult method with a large number of photodiodes which do not measure the real intensity. In such a system the UV intensity could be measured by two light intensity meters according to the invention arranged at the most weakly illuminated points in the channel along the walls.

The number of UV lamps depends partly on the size and capacity of the system and on the translucency (light absorption) of the water/liquids. In case of water having a low translucency the distance between the UV lamps/from

the UV lamps to the centre must be relatively small, about 70 mm. Conversely, if the water has a high translucency, the distance may be increased to about 160 mm. In a preferred embodiment, the inner side of the container is reflective so that the UV radiation is directed toward the centre where the light intensity is measured.

In case of larger containers or where more closely spaced UV lamps are required, the UV lamps are arranged in at least two concentric rings in such a manner that none of the lamps shade each other relative to the centrally positioned device for light intensity measurement.

The invention will be described more fully below with reference to the accompanying drawing, in which

fig. 1	shows a light guide cable for intensity measurement of electromagnetic energy according to a first embodiment of a device for intensity measurement according to the invention,
fig. 2	shows a cross-section of a cable as shown in fig. 1,
fig. 3	shows a cable according to a variant of the first embodiment,
fig. 4	shows a sectional view of a reaction container for a system according to a second aspect of the invention,
figs. 5 to 8	show cross-sectional views of the container with various lamp devices with a light intensity meter,
fig. 9	shows a cross-section like in fig. 2 where the cable is provided with a grey filter,
fig. 10	shows a cross-section like in fig. 3 where the cable is provided with a grey filter,

fig. 11 shows a longitudinal section in a reaction container for a system according to the invention,

fig. 12 shows a cross-section of the reaction container according to fig. 11,

fig. 13 shows a longitudinal section in a channel-shaped reaction container for a system according to the invention, and

fig. 14 shows a cross-section of the reaction container according to fig. 13.

Figure 1 shows a cable 10 for light intensity measurement according to a first embodiment of a device according to the invention. The cable 10 is composed of a first and second dosed silicate light guide 1 and 2 capable of converting electromagnetic radiation from $\lambda \approx 253.7$ nm into $\lambda \approx 430$ nm. The light guides 1 and 2 are closely surrounded by a first edge glass 3 dosed to an absorption value of $\lambda \approx 245$ nm and a second edge glass 4 dosed to an absorption value of $\lambda \approx 260$ nm, respectively. The edge glasses 3 and 4 are inserted into two channels in a jacket 5 of quartz glass. At the end of each of the light guides 1, 2 there is arranged a photodiode 6 which has a great sensitivity in the blue range of the light spectrum and which monitors the amount of light in each of the light guides 1, 2.

The jacket 5 is irradiated with electromagnetic energy in the form of UV light which passes through the quartz glass of the jacket and through the edge glass filters 3 and 4 and further into the light guides 1 and 2. The edge glasses 3 and 4 are dosed with different absorption values so that they just allow UV light with a certain wavelength to pass. The first edge glass 3 is dosed to an absorption value of $\lambda = 245$ nm, and the second edge glass is dosed to an absorption value of $\lambda = 260$ nm.

The UV light with which the first light guide is irradiated is thus UV light with $\lambda \geq 245$ nm, and the UV light with which the second light guide 2 is irradiated is UV light with $\lambda \geq 260$ nm.

The light guides 1 and 2 are dosed so that the UV light is converted into light in the visible range. A photosensor 6 sensitive to blue light is arranged at one end of each of the light guides 1 and 2. It is an ordinary and inexpensive photodiode 6, as the conversion of the UV light in the light guides 1 and 2 means that no special demands are made on the photosensors 6.

Fig. 2 shows a cross-section of the cable in fig. 1. Fig. 3 shows a variant of the cable-shaped preferred embodiment of the invention which contains two sets of light guides as indicated by 1, 2 and 1', 2', respectively. The jacket 5 of quartz glass is provided with four channels for housing the edge glass filters 3, 4 in this embodiment. The light guides 1, 1', 2, 2' and associated edge glass filters 3, 3', 4, 4' are arranged such that there are two light guides 1, 2; 1', 2; 1, 2', 1', 2' with a first and a second edge glass filter at each side of the cable 10. This results in a uniform measurement from both types of dosed edge glass filters 3, 4.

Where the light intensity meters are to be used in connection with a large number of lamps or high power lamps of e.g. 1 kW light energy and more, an outer jacket 22 is added, said jacket being dosed to a grey filter, cf. figs. 9 and 10. Based on the light energy, a grey filter with e.g. 5% attenuation or 10% attenuation, etc. may be selected, thereby avoiding saturation of the associated electronic controller.

Fig. 4 shows a reaction container 20 according to a first embodiment of the second aspect of the invention wherein a plurality of UV lamps 7 is arranged in a circle around the centrally positioned cable-shaped light intensity meter 10 according to the invention. As will be seen from fig. 4, the intensity meter 10 is arranged in parallel with the UV lamps 7 at least in their entire length. In the reaction container 20, the water is admitted at one end of the container and is discharged at the other end (not shown).

Fig. 5 shows a cross-section of a container 20 in which only one UV lamp 7 is positioned. In this embodiment, the lamp 7 is positioned in the centre so that the entire volume of the container is irradiated with the same intensity. The cable 10 for intensity measurement according to the first aspect of the invention is here positioned somewhat away from the inner wall 21 of the container, which preferably includes a reflecting material. The cable 10 is oriented so that both light guides 1, 2 are positioned in such a manner that they are both exposed to the same UV light energy from the lamp 7.

In fig. 6, the intensity meter 10 is placed in the centre of the cylindrical container 20. In this embodiment, the lamp device in the container consists of two lamps 7 which are positioned at their respective sides of the cable 10 in such a manner that both light guides 1, 2 are irradiated uniformly.

In fig. 7, eight UV lamps 7 are arranged in a circle around the centre in the container 20 where a "double" cable 10 for intensity measurement is arranged. In case of a larger number of lamps 7 a cable 10 having two or optionally more sets of light guides is preferred, it being hereby possible to obtain a measurement of the

light intensity as satisfactory as possible. This applies even more in connection with the lamp device shown in fig. 8, where UV lamps are arranged in two circles, viz. an inner circle 7' with four lamps and an outer circle with twelve lamps 7". As the intensity meter 10 has a great sensitivity, even this lamp device allows detection of a defective lamp, irrespective of its position in the lamp device.

The centre in the container in all the embodiments shown in figs. 6-8 will be the most weakly illuminated point in the circular container 20. Measuring the intensity of UV light there provides the certainty that the minimum of energy required to disinfect the water in the reaction container is constantly emitted.

It has moreover been realized by the invention that three as well as four circles of lamps may be arranged, if a high performance of the container is desired in terms of inactivation of bacteria, virus, etc. The proportion between the number of lamps in each circle, however, must be adapted so that the mutual spacing of the lamps is the same, and that this distance corresponds to the distance to the centrally positioned device for intensity measurement according to the invention as defined in the accompanying claims. For drinking water having a transmittance of about 0.98-0.80 a circle of 2-9 UV lamps may be used. In case of two circles, the lamps are distributed with 4 in the inner circle and 8 in the outer one, or 8 and 12, or 9 and 16. In case of three circles, 4 are placed in the inner circle, 6 in the intermediate one and 20 in the outer one. For industrial water having a transmittance of about 0.80-0.50, 1 or 3 lamps may be positioned in each circle. With two circles, 1 is placed in the centre and 6 around it. With 3 circles, 1 is placed in the centre, 6 around it and 12 in the outer circle. If the system is

extended with a fourth circle, 18 are placed in it, and with an additional circle, 24 in it. A typical distance to the container wall is 17.5 mm, alternatively 27.5 mm and between the pipes 70 mm.

Figs. 12 and 13 of the drawing show a system corresponding to the one of fig. 5, except that the container is here a tubular channel 23 in whose longitudinal axis a plurality of specially constructed UV lamps 24 are positioned. The lamps are secured by a socket 25 in the side wall of the channel 23. From the socket the lamp glass arcuately extends into a rectilinear portion which is arranged in the central line of the channel. The intensity meter 10 is positioned at the side wall of the channel opposite the mounting socket of the lamps and extends uninterruptedly in the longitudinal direction of all the lamps, i.e. the UV energy is measured in the entire active length of the channel.

Figs. 14 and 15 of the drawing show a reaction container in the form of an open concrete channel 26. A plurality of cartridges having UV low pressure lamps 27 are mounted in the channel. The electrical installation is gathered in a box 28 at one end of the cartridges. Some carrying rods with sockets for the UV lamps extend down from the boxes 28. It will be appreciated that the installations are water-tight. Light intensity meters 10 are mounted at each side of the channel centrally on the sides in the entire active length of the channel, allowing an unprecedentedly accurate measurement of the UV light intensity in a simple and safe manner.

Patent Claims:

1. A device for intensity measurement of the electromagnetic energy from a lamp device comprising at least one UV lamp preferably of the type arranged in a container in connection with disinfection or photochemical treatment of flowing water or liquids, wherein the radiation intensity is measured using light guide means and sensor means, characterized in that the light guide means comprise

two dosed light guides (1, 2; 1', 2') arranged in parallel with the lamp (7) or lamps (7, 7', 7") preferably in the entire length, and

two differently dosed edge glass filters (3, 4; 3', 4') enclosing each of the light guides (1, 2; 1', 2'), and that the sensor means (6) are positioned at least at one respective end of each of the light guides (1, 2; 1', 2').

2. A device for intensity measurement according to claim 1, characterized in that reflection means are arranged at the respective other ends of the light guides (1, 2; 1', 2').

3. A device for intensity measurement according to claim 1 or 2, characterized in that the first edge glass filter (3, 4; 3', 4') is dosed to a filter wavelength of about 245 nm, and the second edge glass filter (3', 4'; 3, 4) is dosed to a filter wavelength of about 260 nm.

4. A device for intensity measurement according to any one of the preceding claims, characterized in that one or both light guides (1, 2; 1', 2') are dosed for conversion of ultraviolet electromagnetic energy fed

through the edge glass filters (3, 4; 3', 4') into visible light, preferably with a wavelength of about 430-470 nm.

5. A device for intensity measurement according to any preceding claim, characterized in that the sensor means comprise silicone silicon, silicon monocrystal or other form of photodiodes.

6. A device for intensity measurement according to any preceding claim, characterized in that the light guide means comprise two or more light guides (1, 2; 1', 2') arranged in pairs with associated dosed edge glass filters (3, 4; 3', 4').

7. A device for intensity measurement according to any preceding claim, characterized in that the two edge glass filters (3, 4; 3', 4') enclosing the light guides (1, 2; 1', 2') are embedded in a jacket (5) of transparent material, preferably quartz glass with two or more channels arranged in pairs for the edge glass filters (3, 4; 3', 4').

8. A device for intensity measurement according to any one of the preceding claims, characterized in that it additionally comprises an outer jacket (22) dosed as a grey filter depending on the level of the light energy where the device is to be used.

9. A UV treatment system, preferably a UV disinfection system or photochemical reaction system in which a lamp device comprising evenly arranged UV lamps (7; 7', 7") is arranged, characterized in that a device for light intensity measurement (10) according to any preceding claim is arranged in parallel with the lamps (7; 7', 7").

10. A system according to claim 9 having a reaction container of polygonal or circular cross-section in which a lamp device comprising at least one circle of evenly arranged UV lamps (7; 7', 7") is arranged, c h a r a c t e r i z e d in that a device for light intensity measurement (10) according to any preceding claim is arranged in the centre of the circle in parallel with the lamps (7; 7', 7").

11. A system according to claim 10, c h a r a c t e r i z e d in that the inner side (21) of the container is provided with a reflecting surface so that the UV radiation is directed toward the centre, where the light intensity is measured.

12. A system according to claim 10 or 11, c h a r a c t e r i z e d in that the UV lamps (7', 7") are arranged in at least two concentric circles in such a manner that none of the lamps shade each other relative to the centrally positioned device for light intensity measurement (10).

13. A system having a reaction container of polygonal or circular cross-section in which a lamp device comprising one UV lamp is arranged, c h a r a c t e r i z e d in that the UV lamp (7) is positioned in the centre of the container and the intensity meter (10) between the lamp and the container wall (fig. 5).

14. A system according to claim 9 having a channel-shaped reaction container of polygonal, preferably rectangular or circular cross-section in which a lamp device comprising UV lamps (7; 7', 7") evenly arranged in the longitudinal direction of the channel as well as in its cross-section is arranged, c h a r a c t e r i z e d in

that at least one device for light intensity measurement (10) according to any preceding claim is arranged in the longitudinal direction of the channel between the lamps (7; 7', 7") and the inner side of the channel.

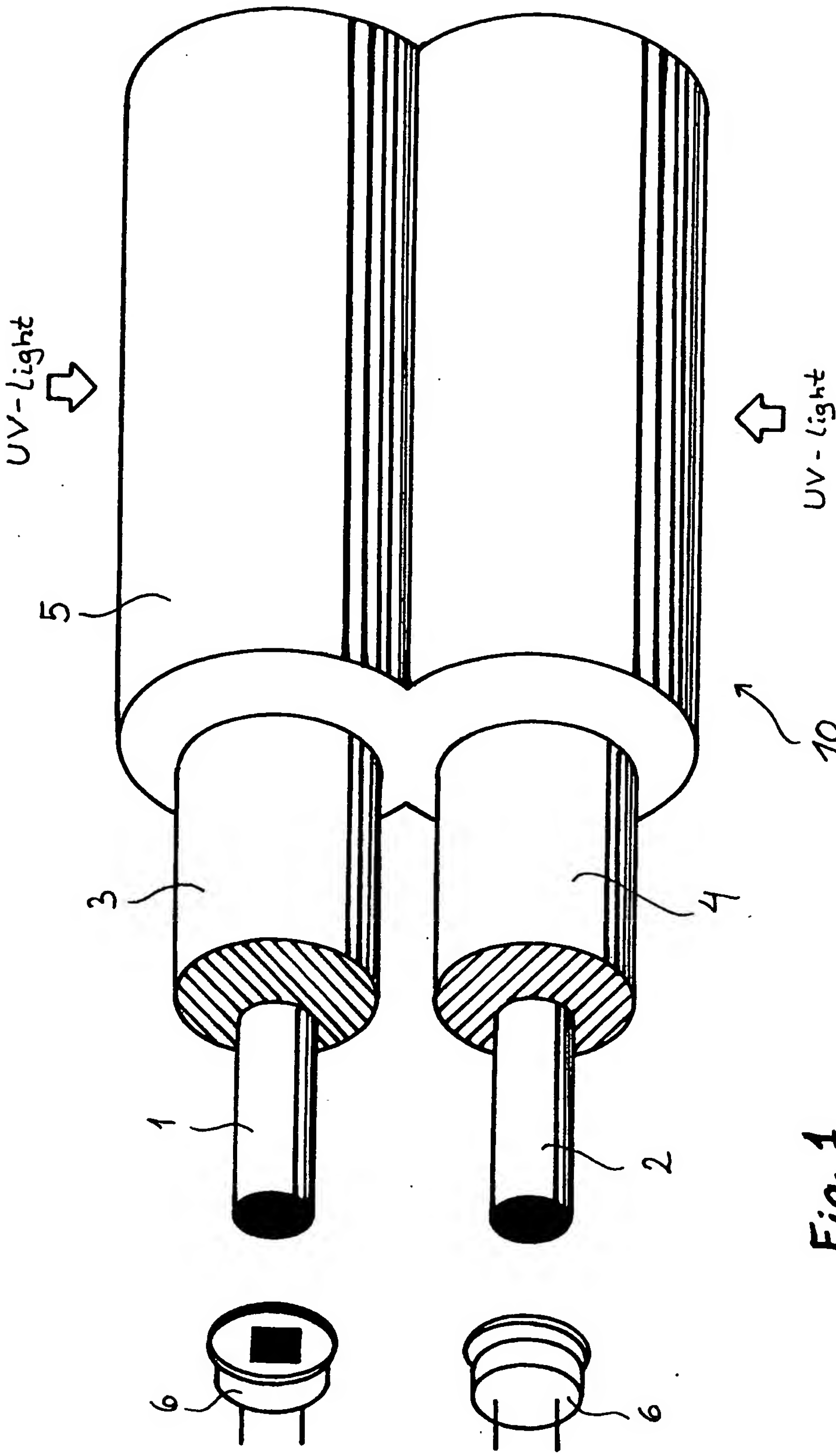

Fig. 1

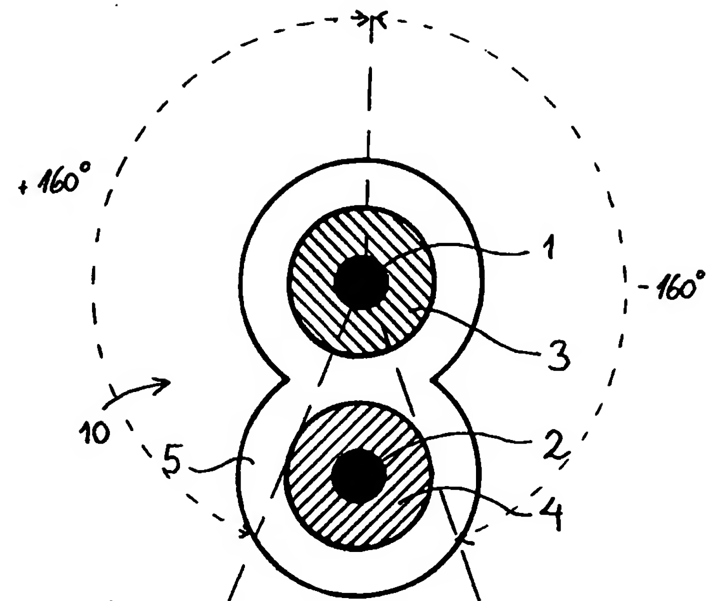

Fig. 2

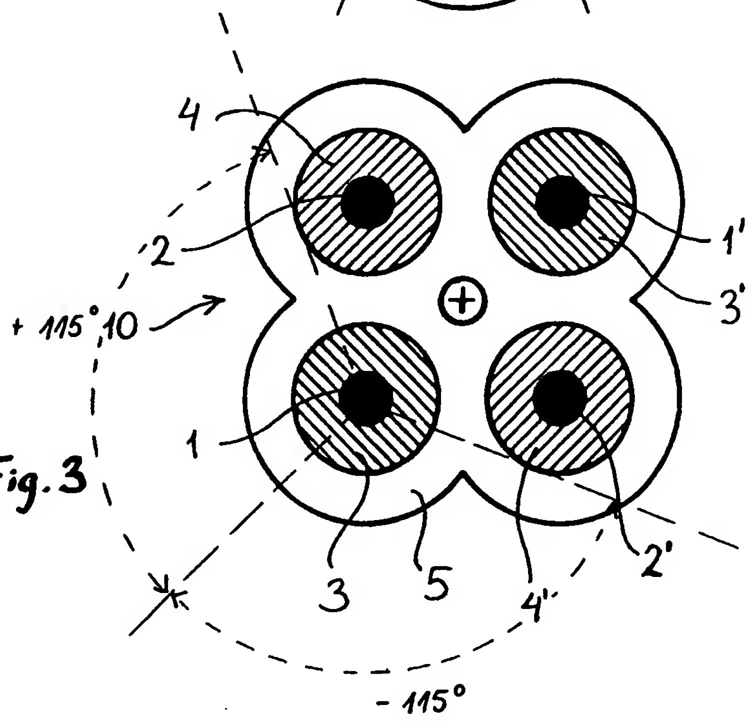

Fig. 3

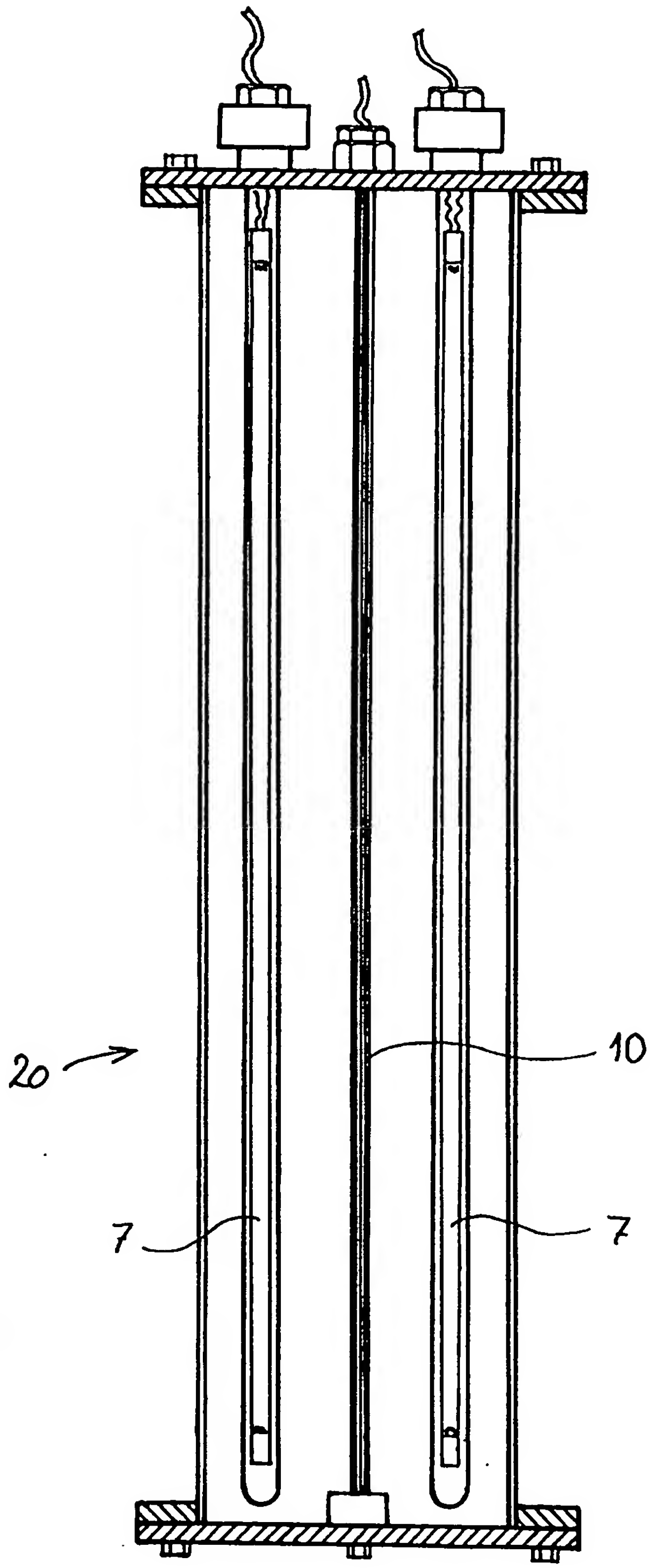

Fig. 4

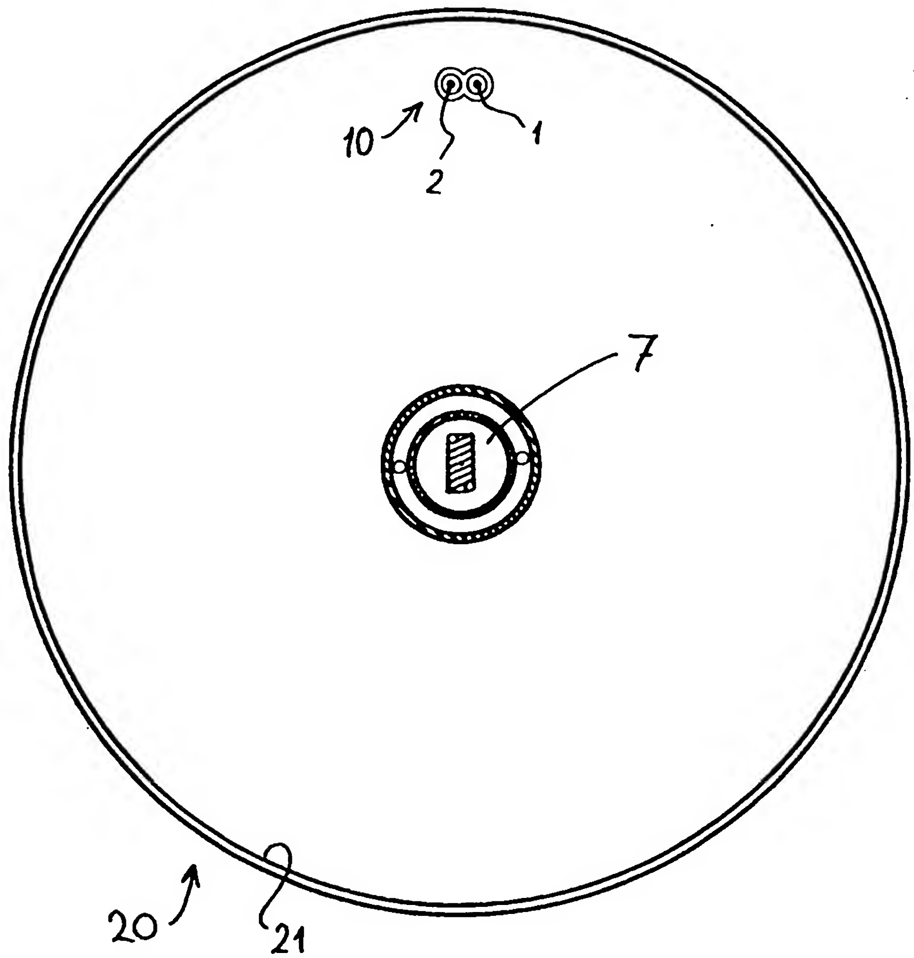

Fig. 5

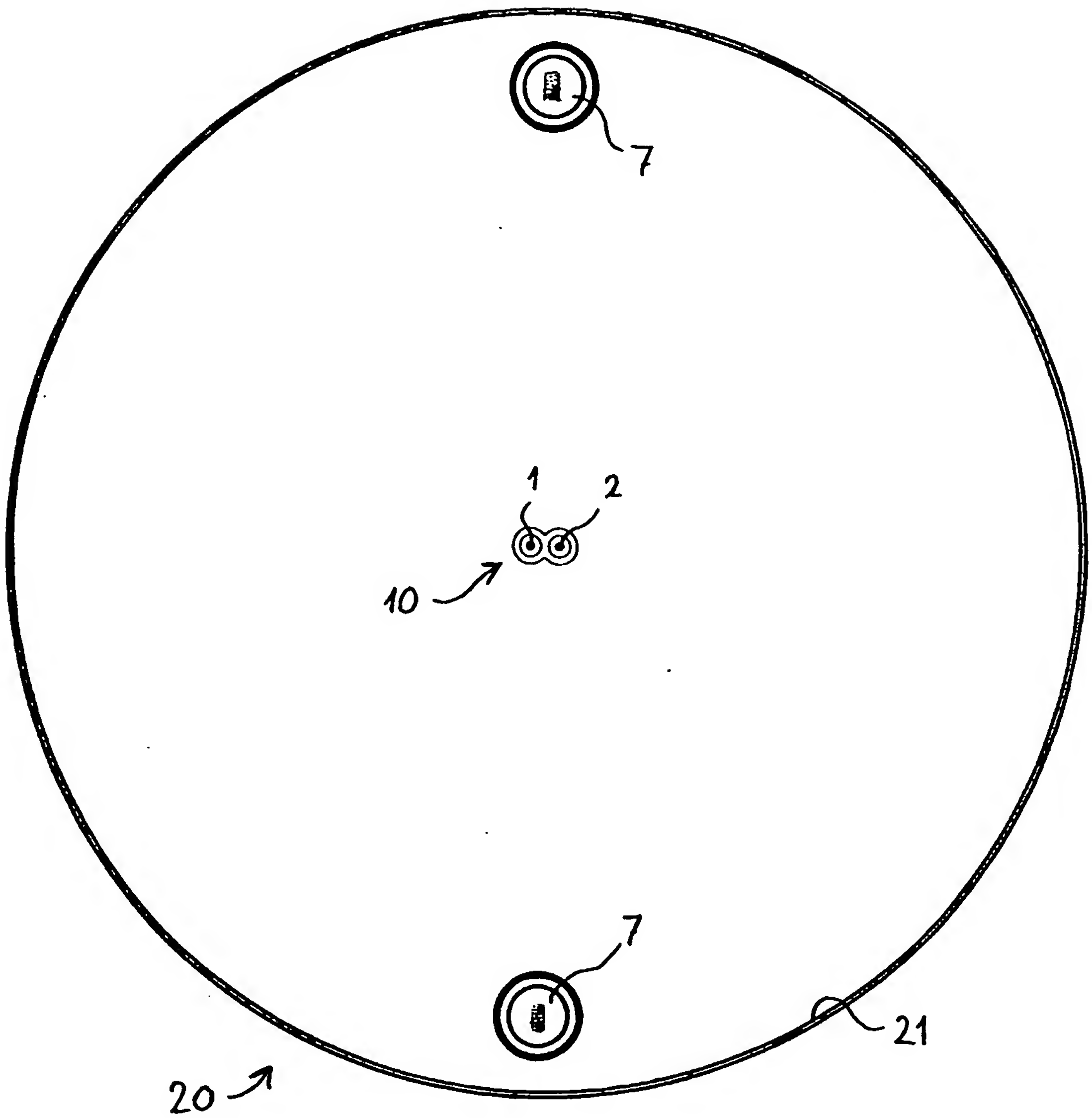

Fig. 6

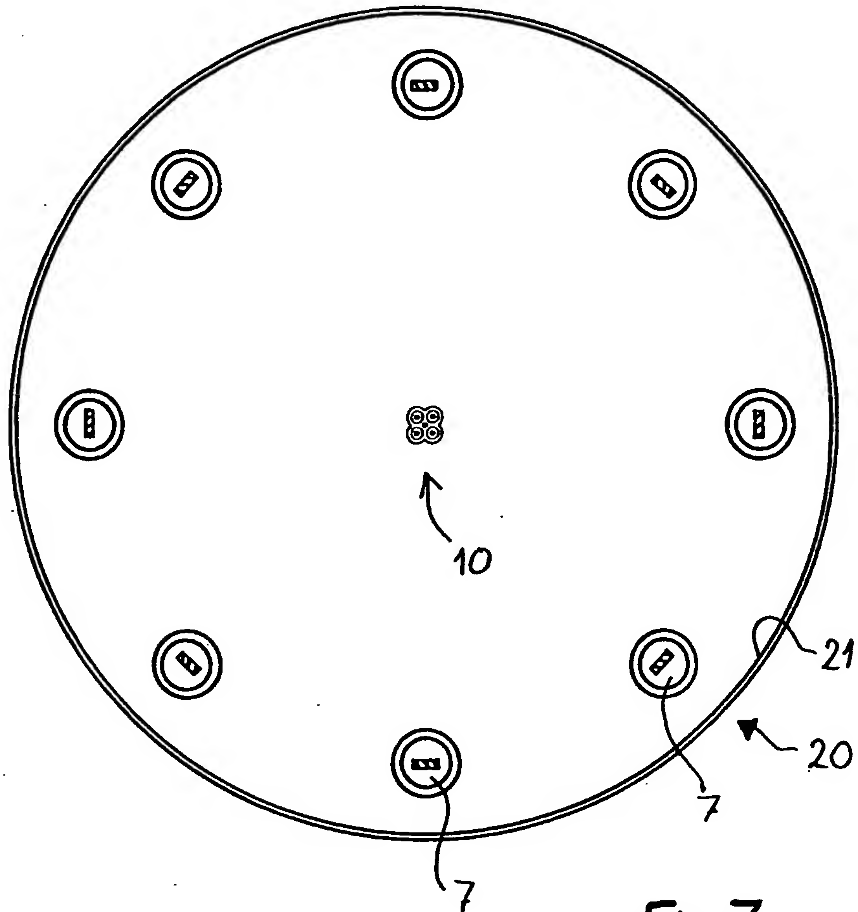

Fig. 7

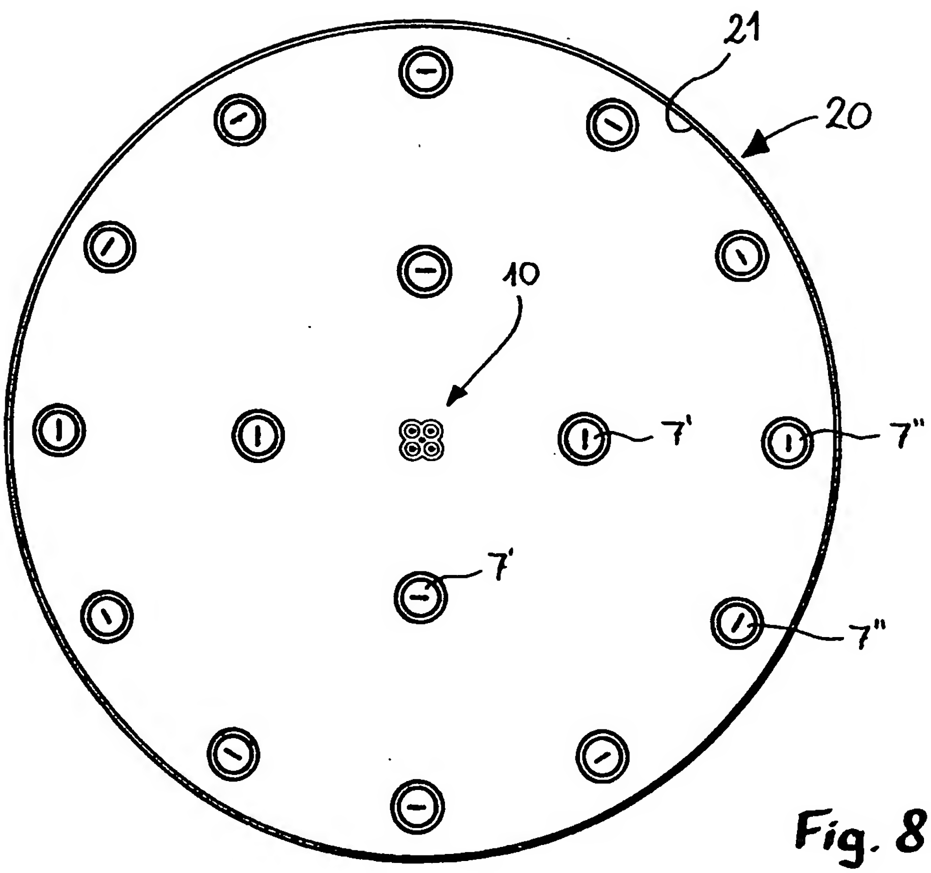

Fig. 8

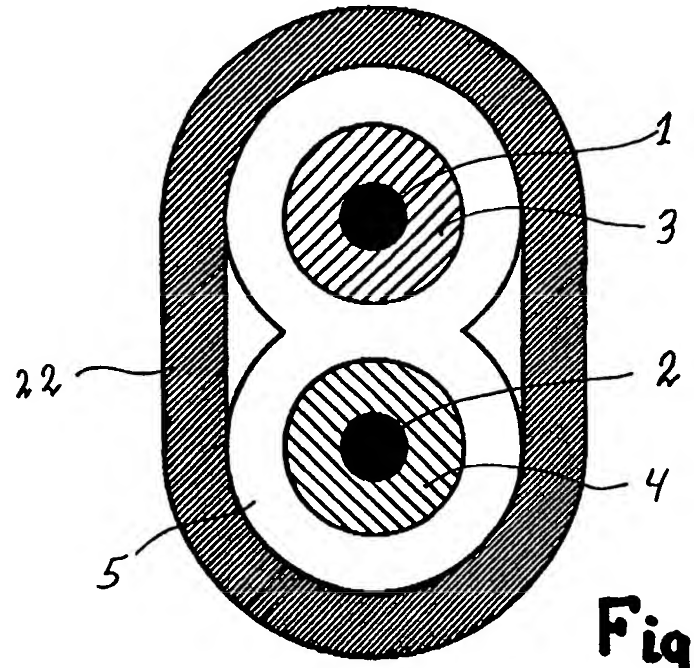

Fig. 9

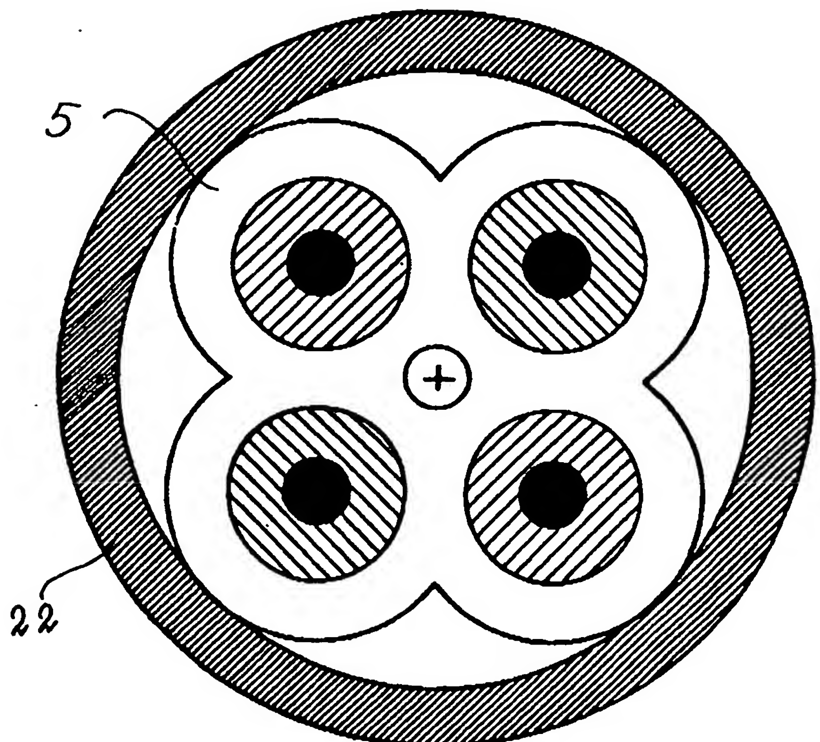

Fig. 10

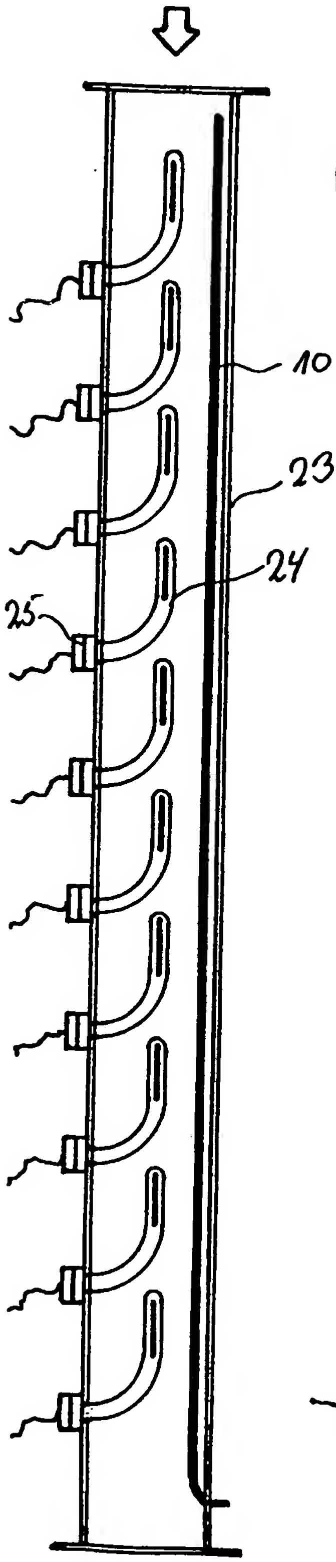

Fig.12

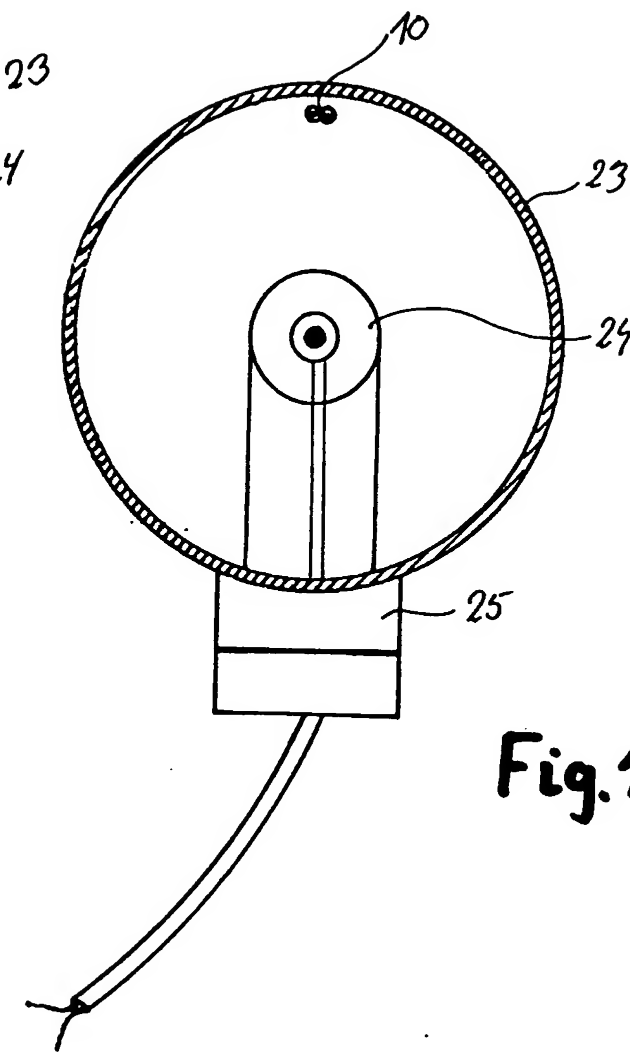

Fig.13

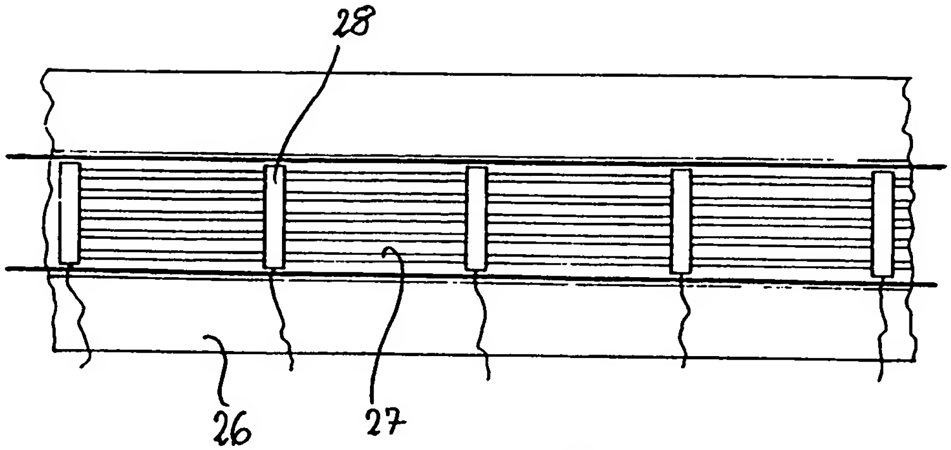

Fig. 14

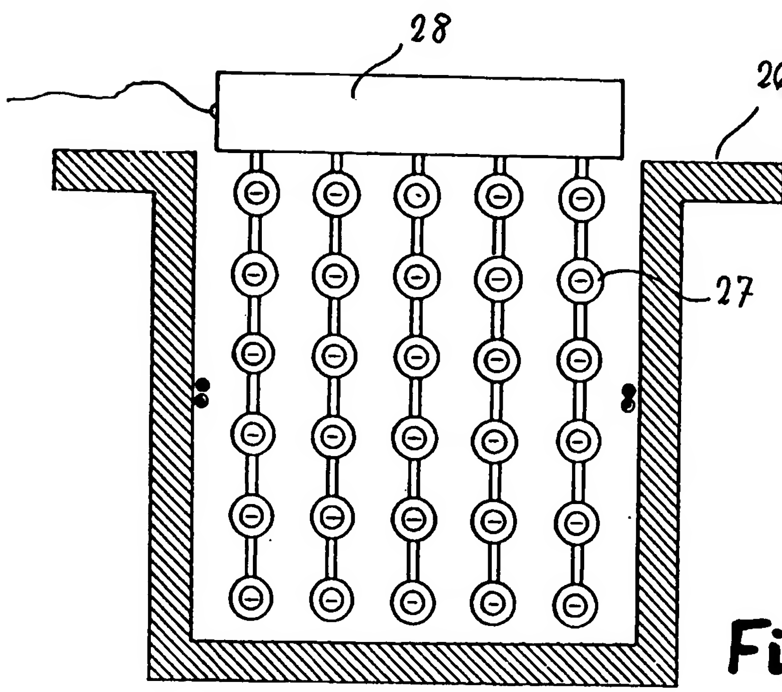

Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 99/00039

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01J 1/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4103167 A (S. ELLNER), 25 August 1978 (25.08.78), column 2, line 59 - column 4, line 41, figures 3A,3B, abstract --	1-14
A	US 4403826 A (H.M PRESBY), 13 Sept 1983 (13.09.83), column 1, line 48 - column 3, line 11, figures 1,5, abstract --	1-14
A	EP 0531159 A1 (FUJITSU LIMITED ET AL.), 10 March 1993 (10.03.93), column 7, line 1 - column 8, line 13, figure 1, abstract --	1-14

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
26 April 1999	24 -05- 1999

Name and mailing address of the ISA/	Authorized officer
Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Karin Säfsten Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 99/00039

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9519553 A1 (TROJAN TECHNOLGIES INC.), 20 July 1995 (20.07.95), page 4, line 14 - page 6, line 25, figure 1, abstract -- --------	1-14

INTERNATIONAL SEARCH REPORT
Information on patent family members

07/04/99

International application No.
PCT/DK 99/00039

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4103167 A	25/08/78	DE 2825672 A	13/12/79
		GB 1602209 A	11/11/81
		US RE34513 E	18/01/94
US 4403826 A	13/09/83	NONE	
EP 0531159 A1	10/03/93	DE 69206925 D,T	30/05/96
		JP 6011389 A	21/01/94
		US 5585915 A	17/12/96
WO 9519553 A1	20/07/95	AU 1410895 A	01/08/95
		CA 2140227 A	14/07/95
		US 5514871 A	07/05/96